

Claims

[c1] What is claimed is:

1. A system for operating a combustion engine, the system comprising:

a combustion engine having at least one combustion chamber operable in at least a first operating mode and a second operating mode;

a pair of electrodes disposed within the at least one combustion chamber; and

an engine control unit (ECU) configured to monitor conductivity between the pair of electrodes and determine spark plug fouling therefrom.

[c2] 2. The system of claim 1 wherein once the ECU determines spark plug fouling, the ECU controls combustion in the at least one combustion chamber based on the conductivity monitored.

[c3] 3. The system of claim 1 wherein the ECU is further configured to determine conductivity between the electrodes during a scavenging period.

[c4] 4. The system of claim 1 wherein the pair of electrodes is a pair of spark plug electrodes.

- [c5] 5. The system of claim 1 incorporated into one of an outboard motor, a stern drive engine, an inboard engine, a motorcycle engine, a scooter engine, an all terrain vehicle engine, a snowmobile engine, and a lawn equipment engine.
- [c6] 6. The system of claim 2 wherein the ECU is further configured to control combustion in the at least one combustion chamber and to switch an operation mode of the at least one combustion chamber from a first operating mode to a second operating mode if spark plug fouling is determined.
- [c7] 7. The system of claim 6 wherein the ECU is further configured to simultaneously switch an operation mode of at least one other combustion chamber from the second operating mode to the first operating mode if spark plug fouling is determined in the at least one combustion chamber.
- [c8] 8. The system of claim 6 wherein the ECU is further configured to selectively operate the at least one combustion chamber and at least one other combustion chamber in the first operating mode and the second operating mode independently.
- [c9] 9. The system of claim 6 wherein the first operating

mode has a fluctuating fuel-to-air mixture and the second operating mode has a substantially constant fuel-to-air mixture.

[c10] 10. The system of claim 1 wherein the ECU is further configured to compare the monitored conductivity to a threshold conductivity indicative of spark plug fouling and operate the at least one combustion chamber in the second operating mode if the monitored conductivity is greater than the threshold conductivity.

[c11] 11. The system of claim 6 wherein the first operating mode is a stratified operating mode and the second operating mode is a homogeneous operating mode.

[c12] 12. The system of claim 6 wherein switching the operation mode of the at least one combustion chamber from the first operating mode to the second operating mode corrects spark plug fouling.

[c13] 13. A method of controlling engine operation, the method comprising:
operating a combustion chamber in a first operation mode;
determining a conductivity between a pair of electrodes within the combustion chamber during a period of low ionization; and then

switching a mode of operating the combustion chamber to a second operation mode if the conductivity between the pair of electrodes during the period of low ionization is indicative of spark plug fouling.

- [c14] 14. The method of claim 13 wherein the first mode of operation is a stratified mode of operation to and the second mode of operation is a homogeneous mode of operation.
- [c15] 15. The method of claim 13 further comprising a scavenging period as the period of low ionization is further defined by.
- [c16] 16. The method of claim 13 further comprising utilizing a pair of spark plug electrodes as the pair of electrodes.
- [c17] 17. The method of claim 13 further comprising switching at least one of an ignition timing, a fuel injection timing, and a fuel mixture.
- [c18] 18. The method of claim 13 further comprising the step of comparing the conductivity to a threshold conductivity and if the conductivity is greater than the threshold conductivity, switching the mode of operating the combustion chamber to correct spark plug fouling.
- [c19] 19. An outboard motor comprising:

a powerhead having a combustion engine, a midsection configured for mounting the outboard motor to a watercraft, and a lower unit powered by the engine to propel a watercraft, the engine having a first electrode and a second electrode operationally disposed within a combustion chamber; and

a computer configured to detect spark plug fouling by placing a voltage across the electrodes and monitoring current that flows between the electrodes within the combustion chamber.

[c20] 20. The outboard motor of claim 19 wherein the computer is further configured to determine a conductivity between the electrodes during a period of low ionization within the combustion chamber.

[c21] 21. The outboard motor of claim 19 wherein the computer is further configured to operate the combustion chamber in a first operating mode unless spark plug fouling is detected, wherein if spark plug fouling is detected the computer is configured to operate the combustion chamber in a second operating mode.

[c22] 22. The outboard motor of claim 21 wherein the first operating mode is a stratified operating mode and the second operating mode is a homogeneous operating mode.

- [c23] 23. The outboard motor of claim 21 wherein the first operating mode includes a first ignition timing and the second operating mode includes a second ignition timing.
- [c24] 24. The outboard motor of claim 21 wherein the second operating mode corrects spark plug fouling and minimizes deposits resulting from spark plug fouling.
- [c25] 25. The outboard motor of claim 19 wherein the pair of electrodes is a spark plug.
- [c26] 26. The outboard motor of claim 19 wherein the combustion engine further comprises another combustion chamber and wherein the computer is further configured to cause combustion within the combustion chamber and the another combustion chamber to occur in a first operation mode and a second operation mode independently.
- [c27] 27. A system for determining spark plug fouling comprising:
means for detecting spark plug fouling; and
means for cleaning any detected fouling spark plug.
- [c28] 28. The system of claim 27 further comprising a means for detecting combustion chamber ionization.
- [c29] 29. The system of claim 27 further comprising means for

changing an operating mode of the combustion chamber if the means for determining spark plug fouling detects a current indicative of spark plug fouling.

[c30] 30. The system of claim 29 wherein the operating mode of the combustion chamber is changed to an operating mode that corrects spark plug fouling.

[c31] 31. The system of claim 29 further comprising a means for simultaneously changing an operating mode of another combustion chamber if the means for changing the operating mode of the combustion chamber changes the operating mode of the combustion chamber.

[c32] 32. The system of claim 31 wherein the operating mode of the combustion chamber is changed to a homogeneous operating mode and the operating mode of the another combustion chamber is changed to a stratified operating mode.

[c33] 33. The system of claim 27 further comprising a means for determining spark plug fouling by detecting if a current induced across the pair of electrodes is indicative of spark plug fouling.